THE IJAMCE JOURNAL

International Journal of Advances in Mechanical and Civil Engineering (IJAMCE)

CURRENT ISSUES

Volume-7,Issue-5 (Oct, 2020)

View More

PAST ISSUES

Volume-7,Issue-5 (Oct, 2020)
Volume-7,Issue-4 (Aug, 2020)
Volume-7,Issue-3 (Jun, 2020)
Volume-7,Issue-2 (Apr, 2020)
Volume-7,Issue-1 (Feb, 2020)
Volume-6,Issue-6 (Dec, 2019)
Volume-6,Issue-5 (Oct, 2019)
Volume-6,Issue-4 (Aug, 2019)
Volume-6,Issue-3 (Jun, 2019)
Volume-6,Issue-2 (Apr, 2019)

View More

STATISTICS REPORT

Jan. 2021

Submitted Papers	:	80
Accepted Papers	:	10
Rejected Papers	:	70
Acc. Perc	:	12%

Cover Page

Zoom

Editor-in-Chief	:	Dr. R. A. Savanur
ISSN (Print)	:	2394-2827
Contact Person	:	Technical Editor
Contact Mail	:	Info.ijamce@gmail.com
Journal Impact Factor	:	3.664
Current Issue	:	Volume-7,Issue-5 (Oct, 2020)

View More

View More

ABOUT IJAMCE

International Journal of Advances in Mechanical and Civil Engineering(IJAMCE) is a scholarly online, open access, peer-reviewed, interdisciplinary and fully refereed journal focusing on theories, methods and applications in Mechanical Engineering and Civil Engineering . It is an international scientific journal that aims to contribute to the constant scientific research and training, so as to promote research in the field of Mechanical and Civil Engineering.

CALL FOR PAPER

Volume-7,Issue-9(Sep, 2020) Coming Shortly....Submit Your Papers Today!!!

Submit Paper Online

JOURNAL INDEXING

K-3 Google "scholar" Link 4 Cosmos COSMOS IMPACT

Readmore

THE IJAMCE JOURNAL

International Journal of Advances in Mechanical and Civil Engineering (IJAMCE)

CURRENT ISSUES

Volume-7,Issue-5 (Oct, 2020)

View More

PAST ISSUES

Volume-7,Issue-5 (Oct, 2020)
Volume-7,Issue-4 (Aug, 2020)
Volume-7,Issue-3 (Jun, 2020)
Volume-7,Issue-2 (Apr, 2020)
Volume-7,Issue-1 (Feb, 2020)
Volume-6,Issue-6 (Dec, 2019)
Volume-6,Issue-5 (Oct, 2019)
Volume-6,Issue-4 (Aug, 2019)
Volume-6,Issue-3 (Jun, 2019)
Volume-6,Issue-2 (Apr, 2019)

View More

STATISTICS REPORT

Jan. 2021

Submitted Papers	:	80
Accepted Papers	:	10
Rejected Papers	:	70
Acc. Perc	:	12%
Issue Published	:	38
Paper Published	:	923
No. Of Authors	:	2466

Contact
Download Product Flyer
Copyright Form
Publication Charges
Download Sample Paper
Publication Ethics and Publication Malpractice Statement

Volume-3,Issue-1 (Feb, 2016)

Total Viewed 1362

Download Citation

Part 1

IRAJ OTHER JOURNALS

View More

IJAMCE UPDATES

IJAMCE Vol-7, Iss-1(Jan 2020)

THE CONFERENCE WORLD

THE CONFERENCE WORLD

IRAJ Upcoming Conference

payment

THE IJAMCE JOURNAL

International Journal of Advances in Mechanical and Civil Engineering (IJAMCE)

CURRENT ISSUES

Volume-7,Issue-5 (Oct, 2020)

View More

PAST ISSUES

Volume-7,Issue-5 (Oct, 2020)
Volume-7,Issue-4 (Aug, 2020)
Volume-7,Issue-3 (Jun, 2020)
Volume-7,Issue-2 (Apr, 2020)
Volume-7,Issue-1 (Feb, 2020)
Volume-6,Issue-6 (Dec, 2019)
Volume-6,Issue-5 (Oct, 2019)
Volume-6,Issue-4 (Aug, 2019)
Volume-6,Issue-3 (Jun, 2019)
Volume-6,Issue-2 (Apr, 2019)

View More

STATISTICS REPORT

Jan. 2021

Submitted Papers	:	80
Accepted Papers	:	10
Rejected Papers	:	70
Acc. Perc	:	12%
Issue Published	:	38
Paper Published	:	923
No. Of Authors	:	2466

Contact
Download Product Flyer
Copyright Form
Publication Charges

Journal Paper

Paper Title : Key Factors For Regional Urban Eco-Drainage Evaluation

Author : Sih Andayani, Bambang. E.Yuwono

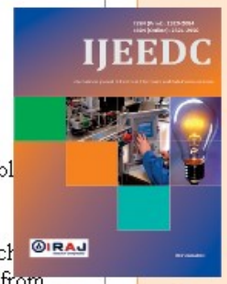
Article Citation : Sih Andayani ,Bambang. E.Yuwono , (2016) " Key Factors For Regional Urban Eco-Drainage Evaluation " , *International Journal of Advances in Mechanical and Civil Engineering (IJAMCE)* , pp. 1-6, Vol 3,Issue-1

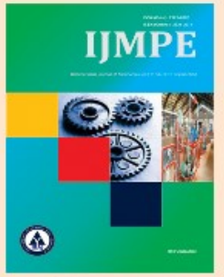
Abstract : During rainy season, people are often experiencing the effects of flood and spatial puddles of water which their activities and inflict both moral and financial loss. Those experiences often result in a desperate urge to be free from flood and spatial puddles of water. Little do they know, that by doing so, it will lead to a drought in the future, because wa from the flood and spatial puddles will not be absorbed deeper into the ground. People will also face a rapid land subsidence as a result of it. Urban eco-drainage is not only functioned to drain the surface water runoff, but also to manage the surface water runoff in order to minimize problems caused by spatial puddles of water, flood, and drought, as well as to be useful for environmental sustainability. Guidelines and researches on urban drainage performance evaluation have been written and conducted several times, but no guideline or handbook is yet to be written on how to evaluate an urban drainage system in an area, in terms of whether that drainage system is suitable with concept of eco-drainage system. The early stage on this research is focused on building a research question, which is to determine key factors that can be used to evaluate and measure an urban drainage system to meet the requirements of an urban eco-drainage concept. Based on the available researches and handbooks on evaluation of urban drainage system, a review was conducted to get all factors and indicators which are allegedly able to be used to measure suitability of urban drainage system with a concept of urban eco-drainage system. The key factors that allegedly can describe whether an urban drainage in an area has been built in accordance with ecological concept, are: (1) technical management, and (2) non-technical management. Technical management consists of five key factors, such as (1)infiltration system, (2) drainage channel system, (3) complementary building systems, (4) storage system and (5) water pump system. Non-technical management consists of two key factors, such as (1) government participation and (2) community role. There are alsoseveral aspects that need to be considered in non-technical management, such as institutional, regulation, financial, socio-cultural, and environmental. Key words- urban eco-drainage, key factors, key indicators.

Type : Research paper

Author - Sih Andayani, Bambang. E.Yuwono

IRAJ OTHER JOURNALS





View More

View More

IJAMCE UPDATES

IJAMCE Vol-7, Iss-1(Jan 2020)

THE CONFERENCE WORLD

THE CONFERENCE WORLD

IRAJ Upcoming Conference

THE IJAMCE JOURNAL

International Journal of Advances in Mechanical and Civil Engineering (IJAMCE)

CURRENT ISSUES

Volume-7,Issue-5 (Oct, 2020)

View More

PAST ISSUES

Volume-7,Issue-5 (Oct, 2020)
Volume-7,Issue-4 (Aug, 2020)
Volume-7,Issue-3 (Jun, 2020)
Volume-7,Issue-2 (Apr, 2020)
Volume-7,Issue-1 (Feb, 2020)
Volume-6,Issue-6 (Dec, 2019)
Volume-6,Issue-5 (Oct, 2019)
Volume-6,Issue-4 (Aug, 2019)
Volume-6,Issue-3 (Jun, 2019)
Volume-6,Issue-2 (Apr, 2019)

View More

STATISTICS REPORT

Jan. 2021

Submitted Papers	:	80
Accepted Papers	:	10
Rejected Papers	:	70
Acc. Perc	:	12%
Issue Published	:	38
Paper Published	:	923
No. Of Authors	:	2466

Contact
Download Product Flyer
Copyright Form
Publication Charges
Download Sample Paper
Publication Ethics and Publication Malpractice Statement

JOIN US

Join Editorial Board
Become a Reviewer
Recommend to Library

Editorial Board

KEY FACTORS FOR REGIONAL URBAN ECO-DRAINAGE EVALUATION

[1]SIH ANDAYANI, [2]BAMBANG. E.YUWONO

[1,2]Department of Civil Engineering Faculty of Civil Engineering and Planning Trisakti University
E-mail: sandajani23@gmail.com, bey_trisakti@yahoo.com

Abstract- During rainy season, people are often experiencing the effects of flood and spatial puddles of water which disturb their activities and inflict both moral and financial loss. Those experiences often result in a desperate urge to be free from flood and spatial puddles of water. Little do they know, that by doing so, it will lead to a drought in the future, because water from the flood and spatial puddles will not be absorbed deeper into the ground. People will also face a rapid land subsidence as a result of it. Urban eco-drainage is not only functioned to drain the surface water runoff, but also to manage the surface water runoff in order to minimize problems caused by spatial puddles of water, flood, and drought, as well as to be useful for environmental sustainability. Guidelines and researches on urban drainage performance evaluation have been written and conducted several times, but no guideline or handbook is yet to be written on how to evaluate an urban drainage system in an area, in terms of whether that drainage system is suitable with concept of eco-drainage system. The early stage on this research is focused on building a research question, which is to determine key factors that can be used to evaluate and measure an urban drainage system to meet the requirements of an urban eco-drainage concept. Based on the available researches and handbooks on evaluation of urban drainage system, a review was conducted to get all factors and indicators which are allegedly able to be used to measure suitability of urban drainage system with a concept of urban eco-drainage system. The key factors that allegedly can describe whether an urban drainage in an area has been built in accordance with ecological concept, are: (1) technical management, and (2) non-technical management. Technical management consists of five key factors, such as (1)infiltration system, (2) drainage channel system, (3) complementary building systems, (4) storage system and (5) water pump system. Non-technical management consists of two key factors, such as (1) government participation and (2) community role. There are alsoseveral aspects that need to be considered in non-technical management, such as institutional, regulation, financial, socio-cultural, and environmental.

Key words- urban eco-drainage, key factors, key indicators.

I. INTRODUCTION

Almost every year, Indonesian people, mostly who live in big cities, are always experiencing the same problem during rainy season. Flood and spatial puddles of water have created more problems and have given them countless financial and moral loss. Illness which appears as a result of the natural disaster, has become another serious problem for them to handle. Dry season is no better due to many other problems that we have to deal with, like drought and water shortage. These problems need to be handled immediately. Another serious environmental problem that we face now besides global warming is the fact that there are many urban drainage designs which are no longer in accordance with their areas condition. Many of the allocation of land lots have been changed from percolation basin area into impervious surface areas. It leads to an increasing surface water runoff level and decreases the amount of water infiltrated into the ground in rainy seasons, as well as groundwater reserves in dry seasons. Thus, drainage design is based on philosophy that water must be quickly streamed down to downstream areas and the public assumption of having lesser amount of spatial puddles of water is considered inappropriate with many areas' current condition. Moreover, with the increasingly imbalance treatment onwater usage towards water availability, drainage design with philosophy of no puddles and in accordance with water conservation principle is heavily needed (Muttaqin, 2007). From that point of view, the writer thinks that sustainable drainage system is more suitable to implement at the moment. The basic concept of sustainable urban drainage system itself is to increase the effectiveness of the water usage, minimize losses, as well as to repair and conserve the environment (Suripin, 2004). For that purpose, comprehensive and integrative efforts are required in the entire process, both structural and nonstructural in nature. Besides having imbalance water treatment, there is also drainage water pollution caused by liquid and solid waste (garbage) which is heavy enough so that the drainage treatment must to be done in integrated and environmentally sound way or eco-drain (Ministry of Public Works, 2012).

By developing urban eco-drainage system, it is expected that the frequency of problems arise like puddles, flood, and drought can be reduced. As a first step, identification can be done to urban drainage system of an area to see whether it is in accordance with eco-drainage concept. If that urban drainage system has not been in accordance with ecological principles, then the next step is to develop urban drainage system in related area into an urban eco-drainage system. Under current condition where government finances is very limited, an action can still be taken by making a priority scale of urban eco-drainage development.

In identifying an area's drainage system, a guideline is needed to assess its suitability with the concept of urban eco-drainage system.

Given the fact that there are large numbers of indicators needed to be assessed, the need for comprehensive and easy-to-understand guidelines for assessing urban eco-drainage is essential for the Evaluators in order to have the same perception towards the criteria of assessment to reduce the subjectivity element in the assessment. Thus the development of the descriptions on the assessment of each influential indicator becomes a very important part in implementing urban eco-drainage assessment. Concept of urban eco-drainageis currently spreading into household scale, communal scale, and region scale (Ministry of Public Works, 2012). Due to a lack of detailed identification of urban eco-drainage concept, in terms of indicators which can illustrate the value of the implementation of an urban eco-drainage system in an area, the research question that is proposed will be about which indicators can illustrate an urban eco-drainage system in an area ?

II. METHODOLOGY

Research method which has been done in this first stage is to (1) have literature reviews related to previous researches and guidelines on performance evaluation of existing urban drainage systems, as well as a standardize the urban eco-drainage concept in order to have factors that allegedly can describe an urban-scale drainage areas in accordance with ecological concept;(2) tabulate all factors whichallegedly can describe an urban-scale drainage area from viewpoints of previous researchers; and (3) bring up strong-allegedly key factors which can describe an urban-scale drainage area by finding outtheir frequency of usage by previous researchers.

In the Handbook of Eco-Drainage (Ministry of Public Works, 2012), the implementation of eco-drainage can be conducted in two ways, i.e. (1) structural action as a solution through constructing drainage facilities, and (2) non-structural action as activities other than constructing waterworks.

Structural actionincludes the condition and function of urban drainage and complementary building facilities, as well as the infrastructure. As for non-structural action, it includes institutional conditions, management, finance, law, as well as the role of the people and private institution. Both of those actions are further divided into three schemes, such as prevention, response, and recovery on a communal houses scale, and an area/region scale. Based on the explanation above, the next components assessed in this study are (1) the technical management which becomes the analogy of the structural actions and (2) non-technical management which becomes the analogy of the non-structural actions.

According to the Handbook of Urban Drainage System (Ministry of Public Works, 2012), urban eco-drainage system is an urban drainage network which consists of main drain, secondary drain, tertiary drain, infiltration building, storage building, and complementary facilities which are all connected systematically. As for examples of complementary facilities are sewers, drop structures, siphon, street inlets, gutter, meeting building, pump and floodgate.

Priority activities should be directed to manage surface runoff by developing its facilities to hold rain water (Suripin 2004). According to their functions, rain water retained facilities can be classified into two types, i.e. (1) storage type, and (2) infiltration type. Storage type includes retarding basin, outdoor regulation pond, parks, school grounds, open land, parking lots, land between the block of houses, and other open spaces. While infiltration type includes trenches or infiltration channels, infiltration basins, reservoirs, and absorption pavements. The procedures for planning outdoor detention basin, retention ponds and reservoirs are found in the Handbook of Urban Drainage System (Ministry of Public Works, 2012). The formula to calculate various infiltration buildings was developed by Ministry of Public Works in a regulation section about standardized building constructions (SK SNI) in 1990, and literatures by Sunyoto (1988), Kusnadi (2011), and Kamir R Brata (2008).

Sub Directorate EPMP on Directorate of Planning and Programming on Water Resources (2005) had made a performance evaluation guideline for irrigation channel network with criteria on (1) how large is the fulfillment capacity on loading channels towards the plans, (2) how large is the deposition of sediment that can still be handled towards the capacity of the channel plan, and (3) how big is the damage that can still be tolerated towards the channel. These criteria can be put analogous for the drainage channels system, absorption or infiltration system, complementary building system, reservoir system, and pump system. Andayani and friends (2011) stated that selecting proper method to handle sediment, vegetation, and garbage is a significant factor in determining the quality of urban drainage service level. Budiartho (2008) also stated that the assessment criteria which can be used to assess a region/site recommended in DAS/DPS, are (1) condition of water quality variables, (2) the waste and waters sediment variables, (3) condition of drainage channel and rivers variables, (4) condition of drainage and infrastructure variables, and (5) variables on central and local government commitment and the role of the public as well as private. In this research, those factors are included as indicators which need to be assessed in the evaluation of eco-drainage.

In her research, Irma Suryanti (2013) assessed the performance of the city's drainage network system in Semarapura in Klungkung Regency based on indicators related to the three aspects, such as (1) technical indicator, (2) maintenance operation indicator, and (3) management indicator. Also in Apriliana's research (Apriliana and colleagues, 2015), she assessed drainage network in sub-district Gandekan in Jebres, Surakarta. The assessment was

based on the physical condition of infrastructure, and both institutional and community participation. Muttaqin (2007) researched several factors : (1) Community role in Regular Maintenance of Drainage Infrastructure, (2) community role in planning infiltration well (SRAH), (3) community understanding in sustainable eco-drainage functioned. Pasaribu (2007) stated that several factors as follows are needed : (1) Determination on Priority Scale in Implementation, Development, and Rehabilitation on Drainage Infrastructure , (2) Establish coordination channel among stakeholders, (3) Socialization of legal regulation/regional regulation, Policies, and community sanctions. Syahrial (2007) stated that Involvement of Indigenous Institutions in socialization is should be take into account.

The assessment components themselves included both physical and non-physical aspects, as it was written in the Local Government Performance Assessment Guidein the Public Works area (PKPD-PU in 2008). Non-physical aspect assessed include regulatory/institutional indicator, development management, efforts done by local government (PEMDA), and the role of both public (PSM) and private sectors. Physical aspect assessed include indicator of physical infrastructure data, function of drainage system infrastructure, and infrastructure's operation and maintenance condition. The assessment method had taken into account the weight of each indicator assessed and scaled according to the scale of assessment. Descriptions of assessment scale is detailed enough, but not yet to cover all aspects needed for conducting urban eco-drainage performance assessment,especially when those aspects are associated with the regional scaled of eco-drainage concept which was previously proposed by the Directorate General of Human Settlements(Cipta Karya) of the Ministry of Public Works, as it is explained in Environmentally sound Drainage Guide (2012).

In 2012, the Director General of Human Settlements of the Ministry of Public Works had enacted the guideline procedures for monitoring and evaluating of the urban drainage management, which are expected to be a main reference for stakeholders in urban drainage field of expertise throughout Indonesia.Indicators which are assessed in this guideline consist of channels' physical condition, water puddles, legal regulations related to drainage infrastructures, workforces to handle the Operation & Maintenance program, the role of the community, and the commitment of the regions themselves. Assessment criteria has already been determined, but have yet to cover all aspects of urban eco-drainage performance assessment, especially when it is associated with region-scaled urban eco-drainage concept which was submitted by the Director General of Human Settlements of the Ministry of Public Works (2012). This assessment is still qualitative in nature and the existing assessment descriptions are not detailed enough. Moreover, there has been no evidence or study related to assessment objectivity. So it is necessary to conduct further research, that the assessment descriptions used are not influenced by Surveyors' subjectivity.

Table 1 The Key Factors / Key Indicators are Assessed in Urban Eco-Drainage System

KEY FACTORS/INDICATORS ASSESSED	REFERENCES
A. Technical Management	
1. Infiltration System	
1.1. Proper selection and establishment of infiltration buildings suitable with the areas' condition	(5), (9), (13), (16)
1.2. Determination of the amount and capacity of infiltration building	(5), (13), (16)
1.3. Selection and establishment of infiltration building's location	(5), (9), (13), (16)
1.4. Waste handling in infiltration system	(4), (7), (9), (11), (13)
1.5. Water quality handling in infiltration system	(1), (4), (5), (9), (1), (16)
1.6. Sediment handling in infiltration system	(1), (4), (7), (8), (9), (11), (13)
1.7. Wild vegetation control in the system	(1), (4), (7)
1.8. Existence of Monitoring and evaluation (MONEV) system and follow-up on infiltration building available functions	(7), (16)
2. DRAINAGE CHANNEL SYSTEM	
2.1. Selection and establishment of drainage channel system suitable with the areas' condition	(1), (11), (16)
2.2. Establishment on drainage channel dimension	(1), (11), (16)
2.3. Selection and establishment on drainage channel system location/ground plan	(8), (11), (16)
2.4. Waste handling on drainage channel	(4), (7), (8), (9), (11), (16)
2.5. Water quality handling on drainage channel	(1), (4), (9), (11)
2.6. Sediment handling in drainage channel	(1), (4), (7), (8), (9), (11), (16)
2.7. Wild vegetation handling in drainage channel	(4), (7), (16)
2.8. Existence of Monitoring and evaluation (MONEV) system and follow-up on drainage system available functions	(7), (9), (16)

3. COMPLEMENTARY BUILDING SYSTEM	
3.1. Selection and establishment on types of complementary building suitable with the areas' condition	(1), (11), (16)
3.2. Determination of complementary building dimension	(1), (11), (16)
3.3. Selection and establishment of complementary building location	(11), (16)
3.4. Proper waste handling on complementary building	(4), (7), (9), (11), (16)
3.5. Sediment handling on complementary building	(1), (4), (7), (8), (9), (11), (16)
3.6. Wild vegetation handling on complementary building	(1), (4), (7), (16)
3.7. Existence of Monitoring and evaluation (MONEV) system and follow-up on complementary building available functions	(7), (9), (16)
4. STORAGE SYSTEM	
4.1. Selection and establishment on types of reservoir building suitable with the areas' condition	(9), (10), (11), (16)
4.2. Selection on the number and the capacity of the reservoir building	(11), (16)
4.3. Selection and establishment of reservoir building location	(9), (11), (16)
4.4. Waste handling in reservoir building	(4), (7), (9), (11), (16)
4.5. Water quality handling in reservoir building	(4), (9), (11)
4.6. Sediment handling in reservoir building	(4), (7), (8), (9), (11), (16)
4.7. Wild vegetation handling in reservoir system	(4), (7), (16)
4.8. Existence of Monitoring and evaluation (MONEV) system and follow-up on available functions of reservoir system	(7), (9), (16)
5. PUMP SYSTEM	
5.1. Proper selection and determination of types of pump suitable with the areas' condition.	(16)
5.2. Determinationof the amount and capacity of pump	(11), (16)
5.3. Selection and determination of pump location	(11), (16)
5.4. Waste handling in pump building	(4), (7), (8), (9), (11), (16)
5.5. Water quality handling in pump building	(4), (9), (11)
5.6. Sediment handling in pump building	(4), (7), (8), (9), (11), (16)
5.7. Wild vegetation control in pump building	(4), (7), (16)
5.8. Existence of Monitoring and evaluation (MONEV) system and follow-up on pump building available functions.	(7), (9), (16)
B. NON-TECHNICAL MANAGEMENT	
6. THE ROLE OF GOVERNMENT	
6.1. Determining Organization that is in charge of O&M (Operation & Maintenance)	(1), (7), (8), (9), (11)
6.2. Establishingworkforce who support Organization assigned in O & M	(1), (7), (8), (9), (11)
6.3. Determination of O & M workforce amount	(1), (7), (8), (9), (11), (16)
6.4. Operating & Maintaining drainage infrastructures regularly/according to schedules	(2), (7), (9)
6.5. Establishment of local government institutions' support on Operation & Maintenance budget	(2), (4), (7), (9), (11)
6.6. Establishment of local government institutions' support on the Development and Rehabilitation on Drainage Infrastructure budget	(7), (9)
6.7. Determination on Priority Scale in Implementation, Development, and Rehabilitation on Drainage Infrastructure	(9), (14)
6.8. Establish coordination channel among stakeholders	(14)
6.9. Giving rewards to the site managers	
6.10. Existence of Legislative Regulations /regional regulation which support Eco-Drainage system	(4), (7), (8), (11)
6.11. Sanctions implementation	(4), (11)
6.12. Socialization of legal regulation/regional regulation, Policies, and community sanctions	(2), (7), (9), (11), (14)
6.13. Involvement of Indigenous Institutions in socialization	(17)
6.14. Follow-up on public complaints	(7)
6.15. Master plan establishment of urban eco-drainage	(7), (9), (10)
7. COMMUNITY PARTICIPATION	
7.1. Community role in Regular Maintenance of Drainage Infrastructure	(2), (4), (7), (8), (9), (11), (12)

7.2. Community role in reporting of any damages on Drainage Infrastructures	(7)
7.3. Community role in reporting of any puddles	(7)
7.4. Community role in giving actual data on sites on the Impacts that occur Post Construction	(12)
7.5. Community role in Planning and Construction Process of Drainage Infrastructure	(7), (9)
7.6. Community role in Planning SRAH	(11), (12)
7.7. Community understanding in sustainable eco-drainage functions	(2), (12)
7.8. Community ability in financing infrastructure damage	(2), (4), (11)

III. RESULTS AND DISCUSSION

From reviewing various previous researches and guidelines which have been issued by the Ministry of Public Works as seen in table 1, factors and indicators which are often discussed in those literatures are components that are set up as key factors and key indicators used in evaluating urban eco-drainage system.

Those components are mainly divided into two, i.e. (1) technical management, and (2) non-technical management. Each of those components consists of several key factors. Key factors for technical management are (1)infiltration system, (2) drainage channel system, (3) complementary building systems, (4) storage system, and (5) water pump system. As for non-technical management, the key factors are(1) government participation and (2) community role. There are several aspects that need to be considered in non-technical management, such as institutional, legal, financial, socio-cultural, and environmental. Moreover, each of key factors consists of several indicators, as it is described in previous section.

The result is used as questionnaire materials which is spread to government officials and ministries that are related to urban drainage management, industrial society, public people, professional organizations, non-governmental organizations, and universities in Indonesia. In this initial research, it is used index value to identify which indicators and factors are important to evaluate whether or not urban drainage in some area has been in accordance with ecological concept. The research using 4 catagories with range 24.75%, namely (1) Not Important/NI (0% - 24.75%), (2) Less Important/LI (24.76% - 49.50%), (3) Important/I (49.51% - 74.25%), (4) Very Important/VI (74.26% - 100%). The result of research which is based on 33 respondent shows that all indicators and factors are important in evaluating whether or not urban drainage in some area has been in accordance with ecological concept. See table 2.

Table 2. Index Value

Indicator	Factor	Index Value (%)	Notes
Infiltration System (A1)	A1.1	93.94	VI
	A1.2	71.97	I
	A1.3	83.33	VI
	A1.4	81.82	VI
	A1.5	82.58	VI
	A1.6	77.27	VI
	A1.7	72.73	I
	A1.8	81.06	VI
Drainage Channel System (A2)	A1.1	88.64	VI
	A1.2	90.15	VI
	A1.3	86.36	VI
	A1.4	86.36	VI
	A1.5	73.48	I
	A1.6	84.09	VI
	A1.7	77.27	VI
	A1.8	81.06	VI
Comple Mentary Building System (A3)	A1.1	79.55	VI
	A1.2	78.79	VI
	A1.3	75.76	VI
	A1.4	80.30	VI
	A1.5	76.52	VI
	A1.6	75.00	VI
	A1.7	76.52	VI
Storage System (A4)	A1.1	84.09	VI
	A1.2	85.61	VI
	A1.3	81.06	VI
	A1.4	82.58	VI
	A1.5	77.27	VI
	A1.6	81.06	VI
	A1.7	75.76	VI
	A1.8	79.55	VI
Pump System (A5)	A1.1	84.09	VI
	A1.2	84.85	VI
	A1.3	83.33	VI
	A1.4	81.06	VI
	A1.5	71.97	I
	A1.6	76.52	VI
	A1.7	71.21	I
	A1.8	81.06	VI
The Role of Government (B6)	B6.1	87.12	VI
	B6.2	85.61	VI
	B6.3	81.06	VI
	B6.4	87.12	VI
	B6.5	88.64	VI
	B6.6	86.36	VI
	B6.7	84.85	VI
	B6.8	75.00	VI
	B6.9	68.94	I
	B6.10	87.88	VI
	B6.11	88.64	VI
	B6.12	84.09	VI

	B6.13	81.06	VI
	B6.14	85.61	VI
	B6.15	88.64	VI
Community Participation (B7)	B7.1	87.12	VI
	B7.2	83.33	VI
	B7.3	81.06	VI
	B7.4	76.52	VI
	B7.5	72.73	I
	B7.6	85.61	VI
	B7.7	86.36	VI
	B7.8	57.58	I

CONCLUSION

From literature review results and index value, the writer found that there are two key factors and seven key indicators which are enabled to use to evaluate whether urban drainage in an area has been properly designed and managed in accordance with environmental perspective. The key factors are (1) technical management, and (2) non-technical management. The key indicators are (1) infiltration system, (2) drainage channel system, (3) complementary building systems, (4) storage system, and (5) water pump system, (6) the role of government, and (7) community participation.

To give better result, researcher will continue the research by spreading more questionnaires to get more respondent and try using another analysis method.

REFERENCES

[1]. Andayani, Yuwono, Soekrasno, ”Operation and Maintenance Role in Evaluation Urban Drainage Service Level”, Civil Engineering Journal, volume III number 1, March 2012, ISSN 2089-9513.

[2]. Apriliana, ”Evaluasi Kinerja Jaringan Drainase Kelurahan Gandekan Jebres Surakarta (Sub Sistem Kali Pepe Hilir)”, Skripsi, 2015.

[3]. Brata, Kamir, “Lubang Resapan Biopori”, Penerbit Penebar Swadaya, 2008.

[4]. Budhiarto, “Proses Pengembangan Sistem Pengelolaan Drainase Secara Terpadu Berwawasan Lingkungan”, 2008.

[5]. Departemen Pekerjaan Umum, “Tata Cara Perencanaan Teknik Sumur Resapan Air Hujan Untuk Lahan Pekarangan”, SK SNI T-06-1990-F, 1990.

[6]. Departemen Pekerjaan Umum, “Tata Cara Perencanaan Drainase Perkotaan”, SK SNI T-07-1990-F, 1990.

[7]. Departemen Pekerjaan Umum, ”Panduan Penilaian Kinerja Pemerintah Daerah Bidang Pekerjaan Umum”, 2008.

[8]. Irma Suryanti, IN.Norken, IG.B.Sila Dharma, “Kinerja Sistem Jaringan Drainase Kota Semarapura di Kabupaten Klungkung”, Jurnal Spektran Vol.1 No.1, Januari 2013.

[9]. Kementerian Pekerjaan Umum, Direktorat Jenderal Cipta Karya, “Panduan Drainase Berwawasan Lingkungan”, 2012.

[10]. Kementerian Pekerjaan Umum, ” Peraturan Menteri Pekerjaan Umum Nomor : 14/PRT/M/2010 tanggal 25 Oktober 2010”.

[11]. Kementerian Pekerjaan Umum, Direktorat Jenderal Cipta Karya, Direktorat Pengembangan Penyehatan Lingkungan Perumahan, “Sistem Drainase Perkotaan Jilid I-IV”, 2012.

[12]. Muttaqin, Yusuf ”Kinerja Sistem Drainase Yang Berkelanjutan Berbasis Partisipasi Masyarakat (Studi Kasus di Perumahan Josroyo Indah Jaten Kabupaten Karanganyar)”, Media Teknik Sipil, Juli 2007.

[13]. Kusnaedi, “Sumur Resapan Untuk Pemukiman Perkotaan dan Pedesaan”, Penerbit Penebar Swadaya, Jakarta, 2011.

[14]. Pasaribu, Dominggo, “Evaluasi Pengelolaan Drainase Kota Medan Secara Terpadu”, Tesis, 2007.

[15]. Perpustakaan Kementerian Pekerjaan Umum, "Drainase Berwawasan Lingkungan,"http://pustaka.pu.go.id/new/artikel-detail.asp?id=331 (diakses 6 Maret 2015)

[16]. Suripin, “Sistem Drainase Perkotaan Yang Berkelanjutan”, Penerbit Andi, Yogyakarta, 2004.

[17]. Syahrial, “Evaluasi Pengelolaan Sistem Drainase Kota Padang”, Tesis, 2007.

★★★

KEY FACTORS FOR REGIONAL URBAN ECO-DRAINAGE EVALUATION

by Sih Andayani, Bambang E. Yuwono

International Journal of Advances in Mechanical and Civil Engineering, ISSN: 2394-2827 Volume-3, Issue-1, Feb.-2016

KEY FACTORS FOR REGIONAL URBAN ECO-DRAINAGE EVALUATION

[1]SIH ANDAYANI, [2]BAMBANG. E.YUWONO

[1,2]Department of Civil Engineering Faculty of Civil Engineering and Planning Trisakti University
E-mail: sandajani23@gmail.com, bey_trisakti@yahoo.com

Abstract- During rainy season, people are often experiencing the effects of flood and spatial puddles of water which disturb their activities and inflict both moral and financial loss. Those experiences often result in a desperate urge to be free from flood and spatial puddles of water. Little do they know, that by doing so, it will lead to a drought in the future, because water from the flood and spatial puddles will not be absorbed deeper into the ground. People will also face a rapid land subsidence as a result of it. Urban eco-drainage is not only functioned to drain the surface water runoff, but also to manage the surface water runoff in order to minimize problems caused by spatial puddles of water, flood, and drought, as well as to be useful for environmental sustainability. Guidelines and researches on urban drainage performance evaluation have been written and conducted several times, but no guideline or handbook is yet to be written on how to evaluate an urban drainage system in an area, in terms of whether that drainage system is suitable with concept of eco-drainage system. The early stage on this research is focused on building a research question, which is to determine key factors that can be used to evaluate and measure an urban drainage system to meet the requirements of an urban eco-drainage concept. Based on the available researches and handbooks on evaluation of urban drainage system, a review was conducted to get all factors and indicators which are allegedly able to be used to measure suitability of urban drainage system with a concept of urban eco-drainage system. The key factors that allegedly can describe whether an urban drainage in an area has been built in accordance with ecological concept, are: (1) technical management, and (2) non-technical management. Technical management consists of five key factors, such as (1)infiltration system, (2) drainage channel system, (3) complementary building systems, (4) storage system and (5) water pump system. Non-technical management consists of two key factors, such as (1) government participation and (2) community role. There are alsoseveral aspects that need to be considered in non-technical management, such as institutional, regulation, financial, socio-cultural, and environmental.

Key words- urban eco-drainage, key factors, key indicators.

I. INTRODUCTION

Almost every year, Indonesian people, mostly who live in big cities, are always experiencing the same problem during rainy season. Flood and spatial puddles of water have created more problems and have given them countless financial and moral loss. Illness which appears as a result of the natural disaster, has become another serious problem for them to handle. Dry season is no better due to many other problems that we have to deal with, like drought and water shortage. These problems need to be handled immediately. Another serious environmental problem that we face now besides global warming is the fact that there are many urban drainage designs which are no longer in accordance with their areas condition. Many of the allocation of land lots have been changed from percolation basin area into impervious surface areas. It leads to an increasing surface water runoff level and decreases the amount of water infiltrated into the ground in rainy seasons, as well as groundwater reserves in dry seasons. Thus, drainage design is based on philosophy that water must be quickly streamed down to downstream areas and the public assumption of having lesser amount of spatial puddles of water is considered inappropriate with many areas' current condition. Moreover, with the increasingly imbalance treatment onwater usage towards water availability, drainage design with philosophy of no puddles and in accordance with water conservation principle is heavily needed (Muttaqin, 2007). From that point of view, the writer thinks that sustainable drainage system is more suitable to implement at the moment. The basic concept of sustainable urban drainage system itself is to increase the effectiveness of the water usage, minimize losses, as well as to repair and conserve the environment (Suripin, 2004). For that purpose, comprehensive and integrative efforts are required in the entire process, both structural and nonstructural in nature. Besides having imbalance water treatment, there is also drainage water pollution caused by liquid and solid waste (garbage) which is heavy enough so that the drainage treatment must to be done in integrated and environmentally sound way or eco-drain (Ministry of Public Works, 2012).

By developing urban eco-drainage system, it is expected that the frequency of problems arise like puddles, flood, and drought can be reduced. As a first step, identification can be done to urban drainage system of an area to see whether it is in accordance with eco-drainage concept. If that urban drainage system has not been in accordance with ecological principles, then the next step is to develop urban drainage system in related area into an urban eco-drainage system. Under current condition where government finances is very limited, an action can still be taken by making a priority scale of urban eco-drainage development.

In identifying an area's drainage system, a guideline is needed to assess its suitability with the concept of urban eco-drainage system.

Given the fact that there are large numbers of indicators needed to be assessed, the need for comprehensive and easy-to-understand guidelines for assessing urban eco-drainage is essential for the Evaluators in order to have the same perception towards the criteria of assessment to reduce the subjectivity element in the assessment. Thus the development of the descriptions on the assessment of each influential indicator becomes a very important part in implementing urban eco-drainage assessment. Concept of urban eco-drainageis currently spreading into household scale, communal scale, and region scale (Ministry of Public Works, 2012). Due to a lack of detailed identification of urban eco-drainage concept, in terms of indicators which can illustrate the value of the implementation of an urban eco-drainage system in an area, the research question that is proposed will be about which indicators can illustrate an urban eco-drainage system in an area ?

II. METHODOLOGY

Research method which has been done in this first stage is to (1) have literature reviews related to previous researches and guidelines on performance evaluation of existing urban drainage systems, as well as a standardize the urban eco-drainage concept in order to have factors that allegedly can describe an urban-scale drainage areas in accordance with ecological concept;(2) tabulate all factors whichallegedly can describe an urban-scale drainage area from viewpoints of previous researchers; and (3) bring up strong-allegedly key factors which can describe an urban-scale drainage area by finding outtheir frequency of usage by previous researchers.

In the Handbook of Eco-Drainage (Ministry of Public Works, 2012), the implementation of eco-drainage can be conducted in two ways, i.e. (1) structural action as a solution through constructing drainage facilities, and (2) non-structural action as activities other than constructing waterworks.

Structural actionincludes the condition and function of urban drainage and complementary building facilities, as well as the infrastructure. As for non-structural action, it includes institutional conditions, management, finance, law, as well as the role of the people and private institution. Both of those actions are further divided into three schemes, such as prevention, response, and recovery on a communal houses scale, and an area/region scale. Based on the explanation above, the next components assessed in this study are (1) the technical management which becomes the analogy of the structural actions and (2) non-technical management which becomes the analogy of the non-structural actions.

According to the Handbook of Urban Drainage System (Ministry of Public Works, 2012), urban eco-drainage system is an urban drainage network which consists of main drain, secondary drain, tertiary drain, infiltration building, storage building, and complementary facilities which are all connected systematically. As for examples of complementary facilities are sewers, drop structures, siphon, street inlets, gutter, meeting building, pump and floodgate.

Priority activities should be directed to manage surface runoff by developing its facilities to hold rain water (Suripin 2004). According to their functions, rain water retained facilities can be classified into two types, i.e. (1) storage type, and (2) infiltration type. Storage type includes retarding basin, outdoor regulation pond, parks, school grounds, open land, parking lots, land between the block of houses, and other open spaces. While infiltration type includes trenches or infiltration channels, infiltration basins, reservoirs, and absorption pavements. The procedures for planning outdoor detention basin, retention ponds and reservoirs are found in the Handbook of Urban Drainage System (Ministry of Public Works, 2012). The formula to calculate various infiltration buildings was developed by Ministry of Public Works in a regulation section about standardized building constructions (SK SNI) in 1990, and literatures by Sunyoto (1988), Kusnadi (2011), and Kamir R Brata (2008).

Sub Directorate EPMP on Directorate of Planning and Programming on Water Resources (2005) had made a performance evaluation guideline for irrigation channel network with criteria on (1) how large is the fulfillment capacity on loading channels towards the plans, (2) how large is the deposition of sediment that can still be handled towards the capacity of the channel plan, and (3) how big is the damage that can still be tolerated towards the channel. These criteria can be put analogous for the drainage channels system, absorption or infiltration system, complementary building system, reservoir system, and pump system. Andayani and friends (2011) stated that selecting proper method to handle sediment, vegetation, and garbage is a significant factor in determining the quality of urban drainage service level. Budiartho (2008) also stated that the assessment criteria which can be used to assess a region/site recommended in DAS/DPS, are (1) condition of water quality variables, (2) the waste and waters sediment variables, (3) condition of drainage channel and rivers variables, (4) condition of drainage and infrastructure variables, and (5) variables on central and local government commitment and the role of the public as well as private. In this research, those factors are included as indicators which need to be assessed in the evaluation of eco-drainage.

In her research, Irma Suryanti (2013) assessed the performance of the city's drainage network system in Semarapura in Klungkung Regency based on indicators related to the three aspects, such as (1) technical indicator, (2) maintenance operation indicator, and (3) management indicator. Also in Apriliana's research (Apriliana and colleagues, 2015), she assessed drainage network in sub-district Gandekan in Jebres, Surakarta. The assessment was

based on the physical condition of infrastructure, and both institutional and community participation. Muttaqin (2007) researched several factors : (1) Community role in Regular Maintenance of Drainage Infrastructure, (2) community role in planning infiltration well (SRAH), (3) community understanding in sustainable eco-drainage functioned. Pasaribu (2007) stated that several factors as follows are needed : (1) Determination on Priority Scale in Implementation, Development, and Rehabilitation on Drainage Infrastructure , (2) Establish coordination channel among stakeholders, (3) Socialization of legal regulation/regional regulation, Policies, and community sanctions. Syahrial (2007) stated that Involvement of Indigenous Institutions in socialization is should be take into account.

The assessment components themselves included both physical and non-physical aspects, as it was written in the Local Government Performance Assessment Guidein the Public Works area (PKPD-PU in 2008). Non-physical aspect assessed include regulatory/institutional indicator, development management, efforts done by local government (PEMDA), and the role of both public (PSM) and private sectors. Physical aspect assessed include indicator of physical infrastructure data, function of drainage system infrastructure, and infrastructure's operation and maintenance condition. The assessment method had taken into account the weight of each indicator assessed and scaled according to the scale of assessment. Descriptions of assessment scale is detailed enough, but not yet to cover all aspects needed for conducting urban eco-drainage performance assessment,especially when those aspects are associated with the regional scaled of eco-drainage concept which was previously proposed by the Directorate General of Human Settlements(Cipta Karya) of the Ministry of Public Works, as it is explained in Environmentally sound Drainage Guide (2012).

In 2012, the Director General of Human Settlements of the Ministry of Public Works had enacted the guideline procedures for monitoring and evaluating of the urban drainage management, which are expected to be a main reference for stakeholders in urban drainage field of expertise throughout Indonesia.Indicators which are assessed in this guideline consist of channels' physical condition, water puddles, legal regulations related to drainage infrastructures, workforces to handle the Operation & Maintenance program, the role of the community, and the commitment of the regions themselves. Assessment criteria has already been determined, but have yet to cover all aspects of urban eco-drainage performance assessment, especially when it is associated with region-scaled urban eco-drainage concept which was submitted by the Director General of Human Settlements of the Ministry of Public Works (2012). This assessment is still qualitative in nature and the existing assessment descriptions are not detailed enough. Moreover, there has been no evidence or study related to assessment objectivity. So it is necessary to conduct further research, that the assessment descriptions used are not influenced by Surveyors' subjectivity.

Table 1 The Key Factors / Key Indicators are Assessed in Urban Eco-Drainage System

KEY FACTORS/INDICATORS ASSESSED	REFERENCES
A. Technical Management	
1. Infiltration System	
1.1. Proper selection and establishment of infiltration buildings suitable with the areas' condition	(5), (9), (13), (16)
1.2. Determination of the amount and capacity of infiltration building	(5), (13), (16)
1.3. Selection and establishment of infiltration building's location	(5), (9), (13), (16)
1.4. Waste handling in infiltration system	(4), (7), (9), (11), (13)
1.5. Water quality handling in infiltration system	(1), (4), (5), (9), (1), (16)
1.6. Sediment handling in infiltration system	(1), (4), (7), (8), (9), (11), (13)
1.7. Wild vegetation control in the system	(1), (4), (7)
1.8. Existence of Monitoring and evaluation (MONEV) system and follow-up on infiltration building available functions	(7), (16)
2. DRAINAGE CHANNEL SYSTEM	
2.1. Selection and establishment of drainage channel system suitable with the areas' condition	(1), (11), (16)
2.2. Establishment on drainage channel dimension	(1), (11), (16)
2.3. Selection and establishment on drainage channel system location/ground plan	(8), (11), (16)
2.4. Waste handling on drainage channel	(4), (7), (8), (9), (11), (16)
2.5. Water quality handling on drainage channel	(1), (4), (9), (11)
2.6. Sediment handling in drainage channel	(1), (4), (7), (8), (9), (11), (16)
2.7. Wild vegetation handling in drainage channel	(4), (7), (16)
2.8. Existence of Monitoring and evaluation (MONEV) system and follow-up on drainage system available functions	(7), (9), (16)

3. COMPLEMENTARY BUILDING SYSTEM	
3.1. Selection and establishment on types of complementary building suitable with the areas' condition	(1), (11), (16)
3.2. Determination of complementary building dimension	(1), (11), (16)
3.3. Selection and establishment of complementary building location	(11), (16)
3.4. Proper waste handling on complementary building	(4), (7), (9), (11), (16)
3.5. Sediment handling on complementary building	(1), (4), (7), (8), (9), (11), (16)
3.6. Wild vegetation handling on complementary building	(1), (4), (7), (16)
3.7. Existence of Monitoring and evaluation (MONEV) system and follow-up on complementary building available functions	(7), (9), (16)
4. STORAGE SYSTEM	
4.1. Selection and establishment on types of reservoir building suitable with the areas' condition	(9), (10), (11), (16)
4.2. Selection on the number and the capacity of the reservoir building	(11), (16)
4.3. Selection and establishment of reservoir building location	(9), (11), (16)
4.4. Waste handling in reservoir building	(4), (7), (9), (11), (16)
4.5. Water quality handling in reservoir building	(4), (9), (11)
4.6. Sediment handling in reservoir building	(4), (7), (8), (9), (11), (16)
4.7. Wild vegetation handling in reservoir system	(4), (7), (16)
4.8. Existence of Monitoring and evaluation (MONEV) system and follow-up on available functions of reservoir system	(7), (9), (16)
5. PUMP SYSTEM	
5.1. Proper selection and determination of types of pump suitable with the areas' condition.	(16)
5.2. Determinationof the amount and capacity of pump	(11), (16)
5.3. Selection and determination of pump location	(11), (16)
5.4. Waste handling in pump building	(4), (7), (8), (9), (11), (16)
5.5. Water quality handling in pump building	(4), (9), (11)
5.6. Sediment handling in pump building	(4), (7), (8), (9), (11), (16)
5.7. Wild vegetation control in pump building	(4), (7), (16)
5.8. Existence of Monitoring and evaluation (MONEV) system and follow-up on pump building available functions.	(7), (9), (16)
B. NON-TECHNICAL MANAGEMENT	
6. THE ROLE OF GOVERNMENT	
6.1. Determining Organization that is in charge of O&M (Operation & Maintenance)	(1), (7), (8), (9), (11)
6.2. Establishingworkforce who support Organization assigned in O & M	(1), (7), (8), (9), (11)
6.3. Determination of O & M workforce amount	(1), (7), (8), (9), (11), (16)
6.4. Operating & Maintaining drainage infrastructures regularly/according to schedules	(2), (7), (9)
6.5. Establishment of local government institutions' support on Operation & Maintenance budget	(2), (4), (7), (9), (11)
6.6. Establishment of local government institutions' support on the Development and Rehabilitation on Drainage Infrastructure budget	(7), (9)
6.7. Determination on Priority Scale in Implementation, Development, and Rehabilitation on Drainage Infrastructure	(9), (14)
6.8. Establish coordination channel among stakeholders	(14)
6.9. Giving rewards to the site managers	
6.10. Existence of Legislative Regulations /regional regulation which support Eco-Drainage system	(4), (7), (8), (11)
6.11. Sanctions implementation	(4), (11)
6.12. Socialization of legal regulation/regional regulation, Policies, and community sanctions	(2), (7), (9), (11), (14)
6.13. Involvement of Indigenous Institutions in socialization	(17)
6.14. Follow-up on public complaints	(7)
6.15. Master plan establishment of urban eco-drainage	(7), (9), (10)
7. COMMUNITY PARTICIPATION	
7.1. Community role in Regular Maintenance of Drainage Infrastructure	(2), (4), (7), (8), (9), (11), (12)

7.2. Community role in reporting of any damages on Drainage Infrastructures	(7)
7.3. Community role in reporting of any puddles	(7)
7.4. Community role in giving actual data on sites on the Impacts that occur Post Construction	(12)
7.5. Community role in Planning and Construction Process of Drainage Infrastructure	(7), (9)
7.6. Community role in Planning SRAH	(11), (12)
7.7. Community understanding in sustainable eco-drainage functions	(2), (12)
7.8. Community ability in financing infrastructure damage	(2), (4), (11)

III. RESULTS AND DISCUSSION

From reviewing various previous researches and guidelines which have been issued by the Ministry of Public Works as seen in table 1, factors and indicators which are often discussed in those literatures are components that are set up as key factors and key indicators used in evaluating urban eco-drainage system.

Those components are mainly divided into two, i.e. (1) technical management, and (2) non-technical management. Each of those components consists of several key factors. Key factors for technical management are (1)infiltration system, (2) drainage channel system, (3) complementary building systems, (4) storage system, and (5) water pump system. As for non-technical management, the key factors are(1) government participation and (2) community role. There are several aspects that need to be considered in non-technical management, such as institutional, legal, financial, socio-cultural, and environmental. Moreover, each of key factors consists of several indicators, as it is described in previous section.

The result is used as questionnaire materials which is spread to government officials and ministries that are related to urban drainage management, industrial society, public people, professional organizations, non-governmental organizations, and universities in Indonesia. In this initial research, it is used index value to identify which indicators and factors are important to evaluate whether or not urban drainage in some area has been in accordance with ecological concept. The research using 4 catagories with range 24.75%, namely (1) Not Important/NI (0% - 24.75%), (2) Less Important/LI (24.76% - 49.50%), (3) Important/I (49.51% - 74.25%), (4) Very Important/VI (74.26% - 100%). The result of research which is based on 33 respondent shows that all indicators and factors are important in evaluating whether or not urban drainage in some area has been in accordance with ecological concept. See table 2.

Table 2. Index Value

Indicator	Factor	Index Value (%)	Notes
Infiltration System (A1)	A1.1	93.94	VI
	A1.2	71.97	I
	A1.3	83.33	VI
	A1.4	81.82	VI
	A1.5	82.58	VI
	A1.6	77.27	VI
	A1.7	72.73	I
	A1.8	81.06	VI
Drainage Channel System (A2)	A1.1	88.64	VI
	A1.2	90.15	VI
	A1.3	86.36	VI
	A1.4	86.36	VI
	A1.5	73.48	I
	A1.6	84.09	VI
	A1.7	77.27	VI
	A1.8	81.06	VI
Comple Mentary Building System (A3)	A1.1	79.55	VI
	A1.2	78.79	VI
	A1.3	75.76	VI
	A1.4	80.30	VI
	A1.5	76.52	VI
	A1.6	75.00	VI
	A1.7	76.52	VI
Storage System (A4)	A1.1	84.09	VI
	A1.2	85.61	VI
	A1.3	81.06	VI
	A1.4	82.58	VI
	A1.5	77.27	VI
	A1.6	81.06	VI
	A1.7	75.76	VI
	A1.8	79.55	VI
Pump System (A5)	A1.1	84.09	VI
	A1.2	84.85	VI
	A1.3	83.33	VI
	A1.4	81.06	VI
	A1.5	71.97	I
	A1.6	76.52	VI
	A1.7	71.21	I
	A1.8	81.06	VI
The Role of Government (B6)	B6.1	87.12	VI
	B6.2	85.61	VI
	B6.3	81.06	VI
	B6.4	87.12	VI
	B6.5	88.64	VI
	B6.6	86.36	VI
	B6.7	84.85	VI
	B6.8	75.00	VI
	B6.9	68.94	I
	B6.10	87.88	VI
	B6.11	88.64	VI
	B6.12	84.09	VI

	B6.13	81.06	VI
	B6.14	85.61	VI
	B6.15	88.64	VI
Community Participation (B7)	B7.1	87.12	VI
	B7.2	83.33	VI
	B7.3	81.06	VI
	B7.4	76.52	VI
	B7.5	72.73	I
	B7.6	85.61	VI
	B7.7	86.36	VI
	B7.8	57.58	I

CONCLUSION

From literature review results and index value, the writer found that there are two key factors and seven key indicators which are enabled to use to evaluate whether urban drainage in an area has been properly designed and managed in accordance with environmental perspective. The key factors are (1) technical management, and (2) non-technical management. The key indicators are (1) infiltration system, (2) drainage channel system, (3) complementary building systems, (4) storage system, and (5) water pump system, (6) the role of government, and (7) community participation.

To give better result, researcher will continue the research by spreading more questionnaires to get more respondent and try using another analysis method.

REFERENCES

[1]. Andayani, Yuwono, Soekrasno, "Operation and Maintenance Role in Evaluation Urban Drainage Service Level", Civil Engineering Journal, volume III number 1, March 2012, ISSN 2089-9513.

[2]. Apriliana, "Evaluasi Kinerja Jaringan Drainase Kelurahan Gandekan Jebres Surakarta (Sub Sistem Kali Pepe Hilir)", Skripsi, 2015.

[3]. Brata, Kamir, "Lubang Resapan Biopori", Penerbit Penebar Swadaya, 2008.

[4]. Budhiarto, "Proses Pengembangan Sistem Pengelolaan Drainase Secara Terpadu Berwawasan Lingkungan", 2008.

[5]. Departemen Pekerjaan Umum, "Tata Cara Perencanaan Teknik Sumur Resapan Air Hujan Untuk Lahan Pekarangan", SK SNI T-06-1990-F, 1990.

[6]. Departemen Pekerjaan Umum, "Tata Cara Perencanaan Drainase Perkotaan", SK SNI T-07-1990-F, 1990.

[7]. Departemen Pekerjaan Umum, "Panduan Penilaian Kinerja Pemerintah Daerah Bidang Pekerjaan Umum", 2008.

[8]. Irma Suryanti, IN.Norken, IG.B.Sila Dharma, "Kinerja Sistem Jaringan Drainase Kota Semarapura di Kabupaten Klungkung", Jurnal Spektran Vol.1 No.1, Januari 2013.

[9]. Kementerian Pekerjaan Umum, Direktorat Jenderal Cipta Karya, "Panduan Drainase Berwawasan Lingkungan", 2012.

[10]. Kementerian Pekerjaan Umum, " Peraturan Menteri Pekerjaan Umum Nomor : 14/PRT/M/2010 tanggal 25 Oktober 2010".

[11]. Kementerian Pekerjaan Umum, Direktorat Jenderal Cipta Karya, Direktorat Pengembangan Penyehatan Lingkungan Perumahan, "Sistem Drainase Perkotaan Jilid I-IV", 2012.

[12]. Muttaqin, Yusuf "Kinerja Sistem Drainase Yang Berkelanjutan Berbasis Partisipasi Masyarakat (Studi Kasus di Perumahan Josroyo Indah Jaten Kabupaten Karanganyar)", Media Teknik Sipil, Juli 2007.

[13]. Kusnaedi, "Sumur Resapan Untuk Pemukiman Perkotaan dan Pedesaan", Penerbit Penebar Swadaya, Jakarta, 2011.

[14]. Pasaribu, Dominggo, "Evaluasi Pengelolaan Drainase Kota Medan Secara Terpadu", Tesis, 2007.

[15]. Perpustakaan Kementerian Pekerjaan Umum, "Drainase Berwawasan Lingkungan,"http://pustaka.pu.go.id/new/artikel-detail.asp?id=331 (diakses 6 Maret 2015)

[16]. Suripin, "Sistem Drainase Perkotaan Yang Berkelanjutan", Penerbit Andi, Yogyakarta, 2004.

[17]. Syahrial, "Evaluasi Pengelolaan Sistem Drainase Kota Padang", Tesis, 2007.

★★★

KEY FACTORS FOR REGIONAL URBAN ECO-DRAINAGE EVALUATION

ORIGINALITY REPORT

5%	2%	1%	4%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to INTI International University Student Paper	3%
2	www.ircwash.org Internet Source	1%
3	wes-riunicef.org Internet Source	<1%
4	Submitted to Syiah Kuala University Student Paper	<1%
5	www.scribd.com Internet Source	<1%
6	doaj.org Internet Source	<1%

Exclude quotes	On	Exclude matches	< 8 words
Exclude bibliography	On		